

## **Electrolux Home Products**

Application  
For Certification  
**User Interface with Transmitter**

**FCC ID: ABMELU81A**

April 28, 2004



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## 1.0 GENERAL DESCRIPTION

### 1.1 Related Submittals Grants

This is single application of the Electrolux Home Products *User Interface with Transmitter* for Certification under FCC Part 15, Subpart C.

There are no other simultaneous applications.

The Receiver portion will be verified under Declaration of Conformity.

### 1.2 Product Description

*User Interface with Transmitter* is a RF transmitter operating in 915MHz. The intended use of the *User Interface with Transmitter* is to generate and transmit a RF signal with freezer status data to receiver. *User Interface with Transmitter* powered at 5VDC.

#### Antenna Description:

Integrated antenna

Sample Submitted: April 8, 2004  
Test Work Started: April 8, 2004  
Test Work Completed: April 12, 2004

### 1.3 Test Methodology

Emission measurements were performed according to the procedures in ANSI C63.4-2000. All field strength radiated emissions measurements were performed in the semi-anechoic chamber, and for each scan, the procedure for maximizing emissions in Appendices D and E were followed. All field strength radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application.

### 1.4 Test Facility

The test site facility used to collect the radiated and conducted measurement data is located at 7250 Hudson Blvd., Suite 100, Oakdale, Minnesota. This test facility has been fully described in a report dated on March 2003 submitted to FCC. Please reference the site registration number: 90706, dated April 18, 2003.

## **2.0 SYSTEM TEST CONFIGURATION**

### **2.1 Justification**

N/A

### **2.2 EUT Setup**

For simplicity of testing, the transmitter was wired to transmit continuously and tested with no plastic enclosure. The freezer Electronic Control Unit including the Power Supply (ECU) was assembled on the test fixture to provide data and 5VDC for the *User Interface with Transmitter*.

### **2.3 EUT Exercising Software**

N/A

### **2.4 Special Accessories**

There are no special accessories necessary for compliance of these products.

### **2.5 Equipment Modification**

No modifications were installed during the testing.

### **2.6 Support Equipment List and Description**

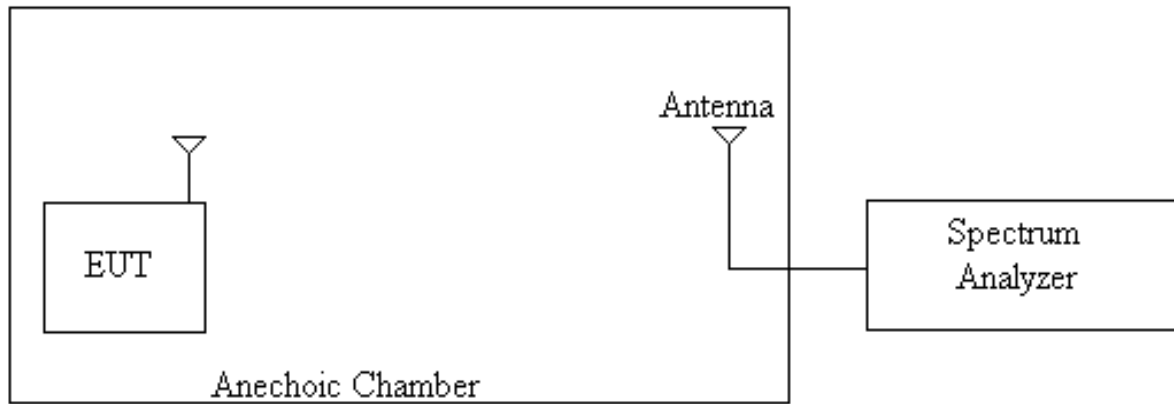
Freezer Electronic Control Unit including the Power Supply (ECU) assembled on the test fixture by Electrolux Home Products.

## 2.7 Test Configuration Block Diagrams

The EUT was setup as tabletop equipment.

The EUT was powered at 5VDC from the Electronic Control Unit Power Supply (ECU).

### Field Strength Measurements



### 3.0 TEST RESULTS

Data is included for the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs, data tables and graphical representations of the emissions are included.

The EUT is intended for operation under the requirements of Part 15 Subpart C. Specific test requirements include the following:

|                             |                                |
|-----------------------------|--------------------------------|
| 47 CFR 15.249(a)(b)         | Field Strength of Fundamental  |
| 47 CFR 15.249(a)(b), 15.205 | Field Strength of Harmonics    |
| 47 CFR 15.249(c), 15.209    | Out of Band Spurious Emissions |
|                             | Bandwidth of Emissions         |
| 47 CFR 15.207               | Line Conducted Emissions       |

Note: A Conducted emissions testing was performed for the Electronic Control Unit Power Supply, which provides 5VDC power for the transmitter.

### **3.1 Field Strength of Fundamental and Harmonics Emissions, FCC 15.249(a)**

Field Strength of Fundamental at 914.99MHz.

The EUT complies with the Standard requirements for Fundamental Emissions with minimum margin 1.9dB for Fundamental Emissions.

The Table 3-1-1 shows the Field Strength of Fundamental Radiation.

**Note:** Correction Factor in the Table includes the Antenna Factor and Cable Loss.

**Radiated Emissions of Fundamental**
**Date:** 04-12-2004

**Company:** Electrolux Home Products  
**Model:** User Interface with Transmitter  
**Test Engineer:** Norman Shpilsher  
**Special Info:**  
**Standard:** FCC Part 15.249(a)  
**Test Site:** 3m Anechoic Chamber, 3m measurement distance  
**Note:** The table shows the worst case radiated emissions  
 All measurements were taken using a CISPR Quasi-peak detector

**Table # 3-1-1**

| Frequency<br>MHz | Antenna  |         |               | QP reading<br>dB $\mu$ V | Total QP<br>dB $\mu$ V/m | QP Limit<br>dB $\mu$ V/m | Margin<br>dB | Comments |
|------------------|----------|---------|---------------|--------------------------|--------------------------|--------------------------|--------------|----------|
|                  | Polarity | Hts(cm) | Factor(dB1/m) |                          |                          |                          |              |          |
| 914.99           | V        | 100     | 25.1          | 63.4                     | 88.5                     | 94.0                     | -5.5         |          |
| 914.99           | H        | 141     | 25.1          | 67.0                     | 92.1                     | 94.0                     | -1.9         |          |

**Comments:**

### 3.2 Field Strength of Harmonics Emissions, FCC 15.249(a), 15.205

Field Strength of Harmonics Emissions measurements were made up to 10<sup>th</sup> harmonic.

The EUT complies with the Standard requirements for Harmonics Emissions with minimum margin 5.3dB.

The Table 3-2-1 and Graphs 3-2-1 and 3-2-2 show the Field Strength Harmonics Emissions.

**Note:** Emission level shown on the Graph includes the Antenna Factor, Cable Loss; Pre-amplifier gain also included (for measurements above 1GHz). Total Factor in the Table includes all above factors.

# Harmonics and Spurious Radiated Emissions

**Date:** 04-12-2004

**Company:** Electrolux Home Products  
**Model:** User Interface with Transmitter  
**Test Engineer:** Norman Shpilsher  
**Special Info:**  
**Standard:** FCC Part 15.249(a)  
**Test Site:** 3m Anechoic Chamber, 3m measurement distance  
**Note:** The table shows the worst case radiated emissions  
All measurements were taken using a Peak detector

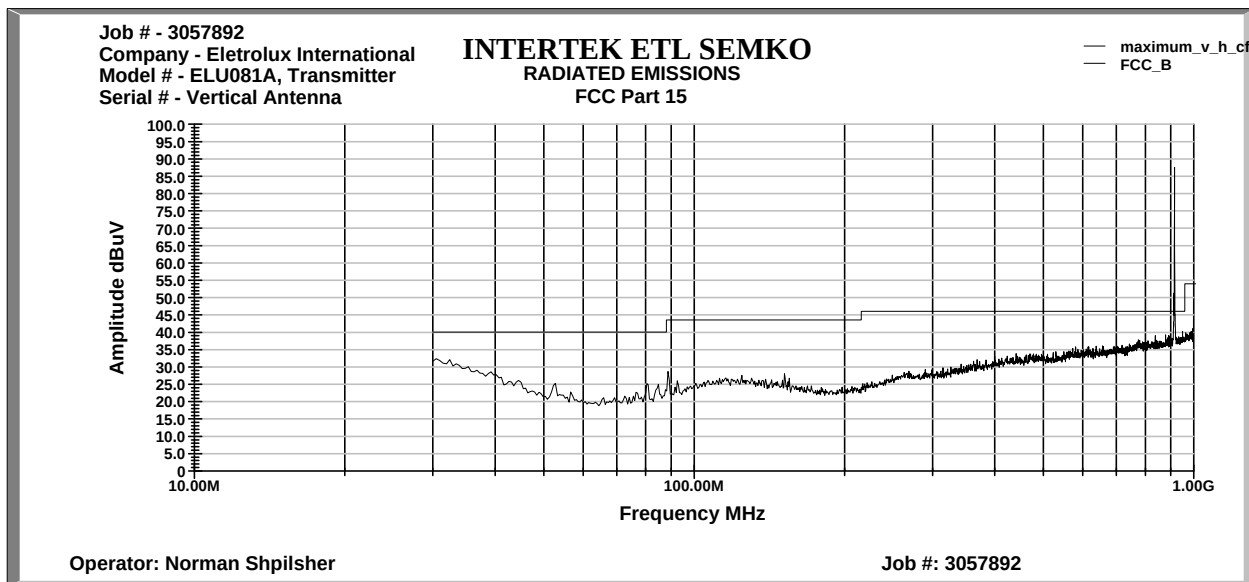
**Table # 3-2-1**

| Frequency<br>MHz | Antenna  |         | Total Factor<br>dB1/m | Peak reading<br>dB $\mu$ V | Total at 3m<br>dB $\mu$ V/m | Limit<br>dB $\mu$ V/m | Margin<br>dB | Comments |
|------------------|----------|---------|-----------------------|----------------------------|-----------------------------|-----------------------|--------------|----------|
|                  | Polarity | Hts(cm) |                       |                            |                             |                       |              |          |
| 4530.50          | V        | 121     | 7.8                   | 39.1                       | 46.9                        | 54.0                  | -7.1         |          |
| 5272.10          | V        | 115     | 9.1                   | 39.6                       | 48.7                        | 54.0                  | -5.3         |          |
|                  |          |         |                       |                            |                             |                       |              |          |
| 2444.90          | H        | 100     | -0.3                  | 39.9                       | 39.7                        | 54.0                  | -14.3        |          |
| 2.695.3          | H        | 100     | 0.8                   | 39.2                       | 39.9                        | 54.0                  | -14.0        |          |
| 4253.20          | H        | 105     | 7.2                   | 37.2                       | 44.4                        | 54.0                  | -9.6         |          |
| 4636.60          | H        | 117     | 8.0                   | 36.2                       | 44.2                        | 54.0                  | -9.8         |          |
| 5032.90          | H        | 100     | 8.8                   | 36.4                       | 45.2                        | 54.0                  | -8.8         |          |
| 5392.00          | H        | 100     | 9.3                   | 36.2                       | 45.5                        | 54.0                  | -8.5         |          |

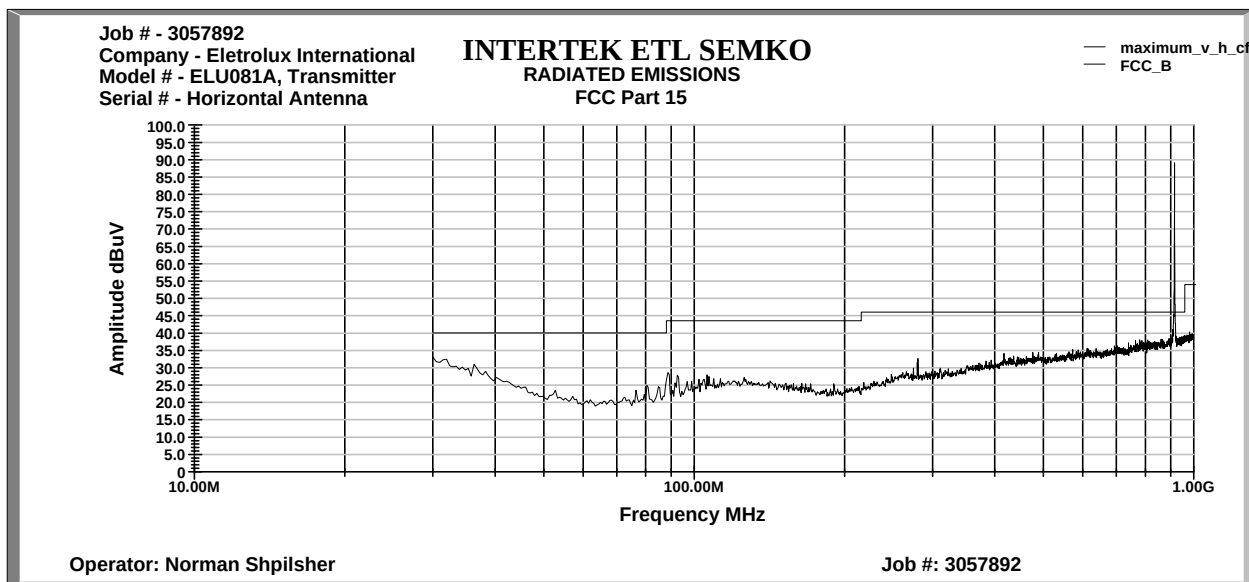
**Comments:**

**Graph # 3-2-1**  
**Harmonics and Spurious Emissions from 30MHz to 1GHz**

**Vertical Antenna Polarization**

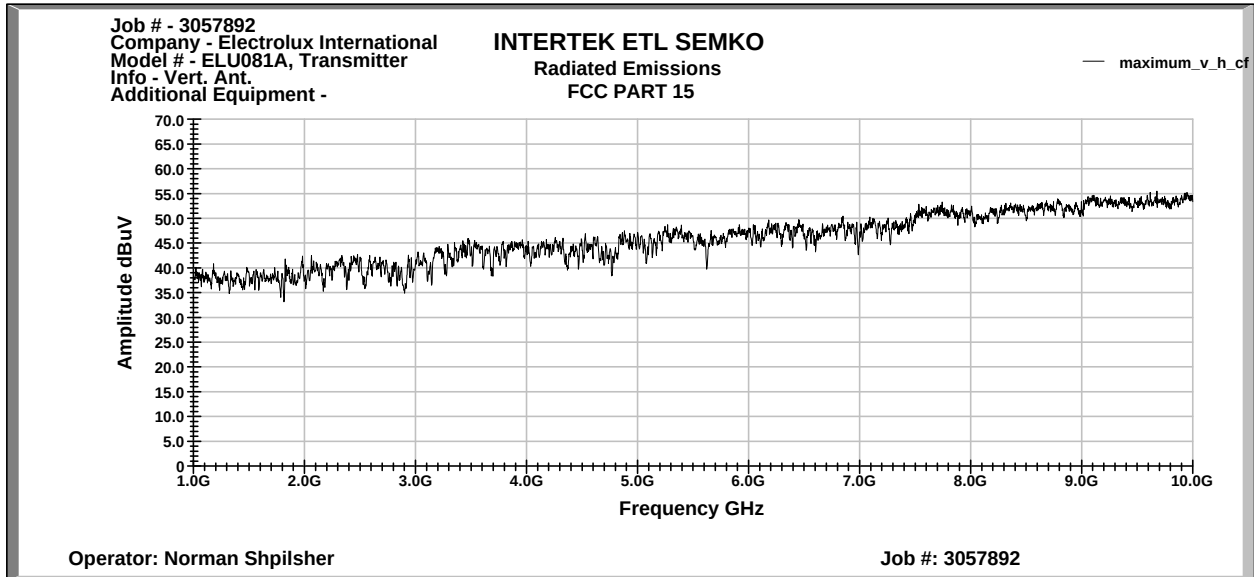


**Horizontal Antenna Polarization**

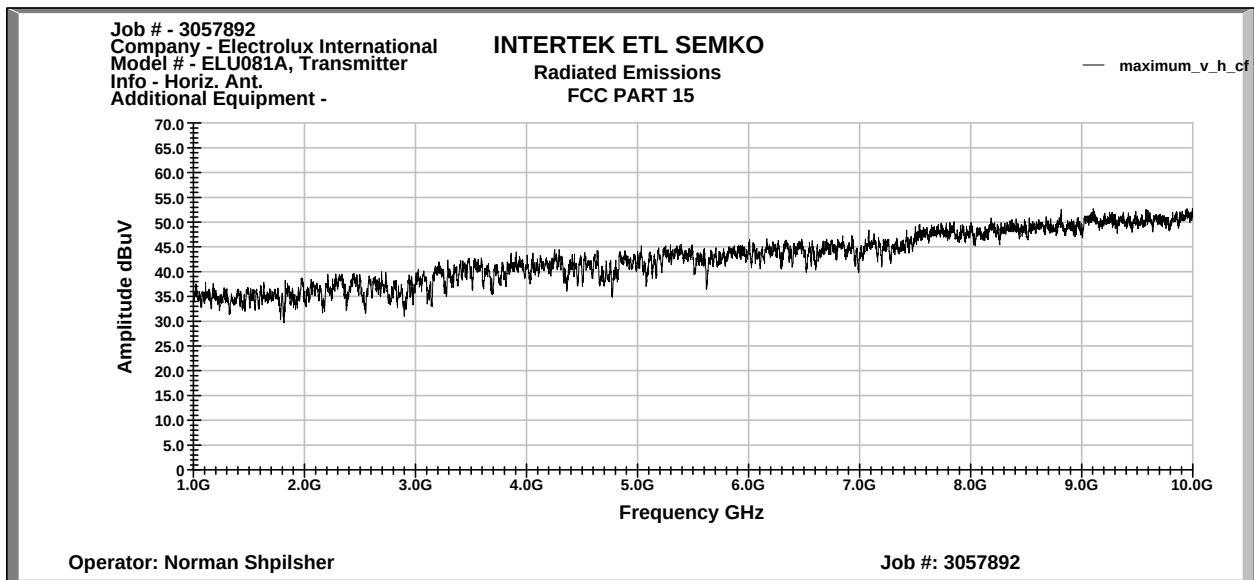


**Graph # 3-2-2**  
**Harmonics and Spurious Emissions from 1GHz to 10GHz**

**Vertical Antenna Polarization**



**Horizontal Antenna Polarization**



### 3.3 Out of Band Spurious Emissions, FCC 15.249(c), 15.209

Out-of-band measurements were made for frequencies:

902MHz

928MHz.

Output frequencies of the EUT was 915MHz

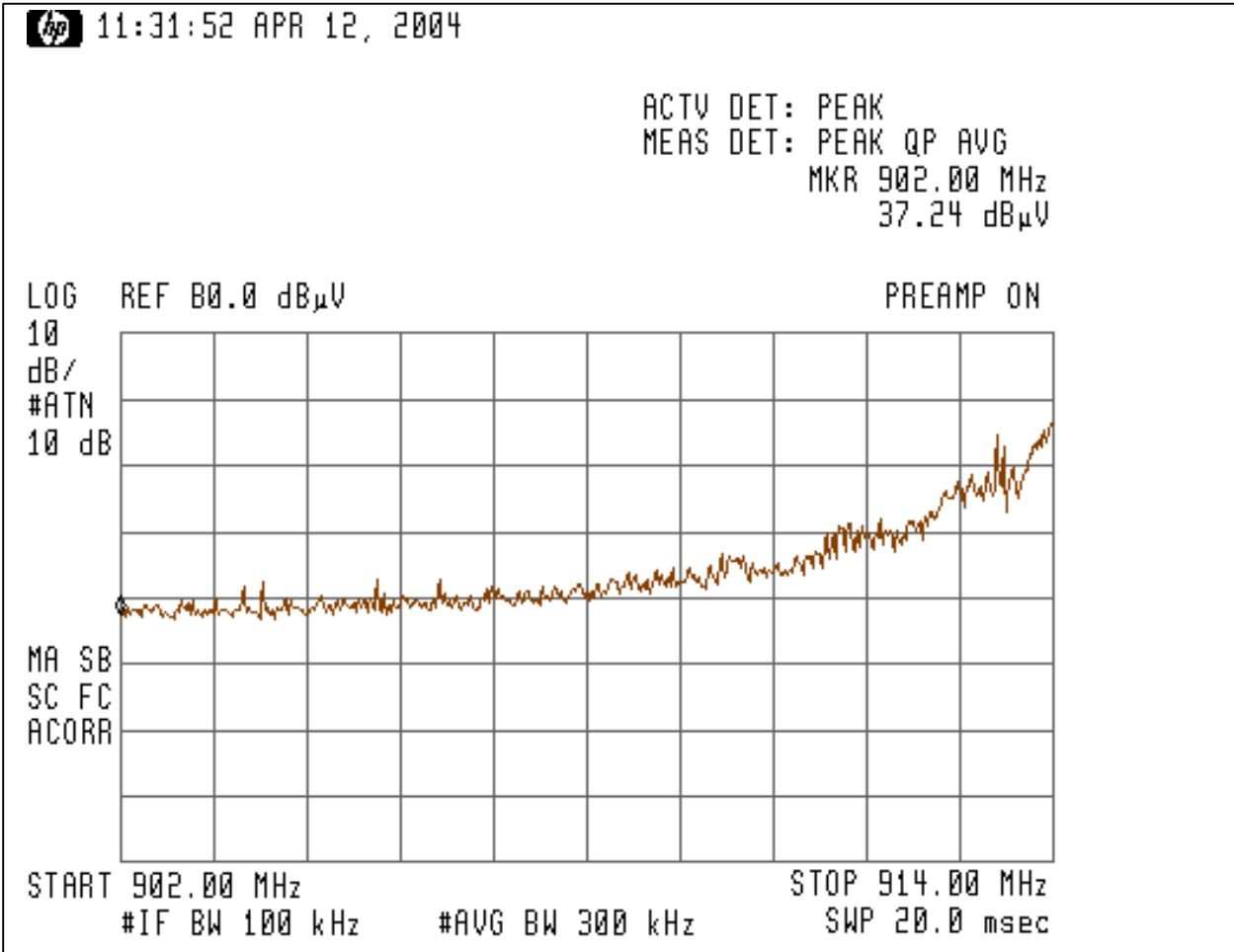
The EUT complies with the Standard requirements Out of Band Spurious Emissions for Section 15.209 as well as for Section 15.249(c).

The Graph 3-3-1 shows the Out of Band Spurious Emissions at 902MHz.

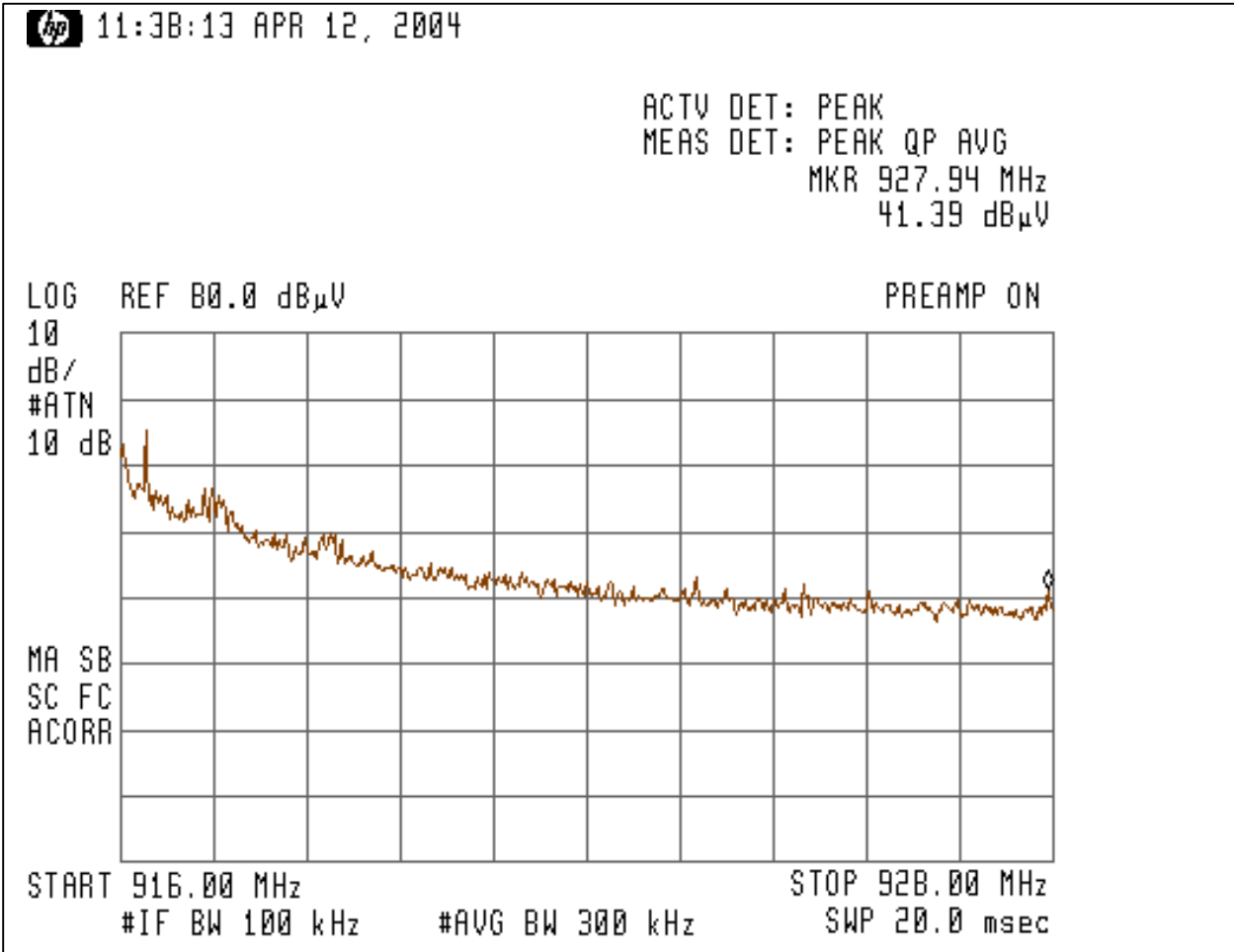
The Graph 3-3-2 shows the Out of Band Spurious Emissions at 928MHz.

**Note:** Emission level shown in the Graphs includes the Antenna Factor and Cable Loss. No Pre-amplifier was used during measurements.

**Graph # 3-3-1**  
**Out of Band Emissions at 902MHz**



Graph # 3-3-2  
Out of Band Emissions at 928MHz



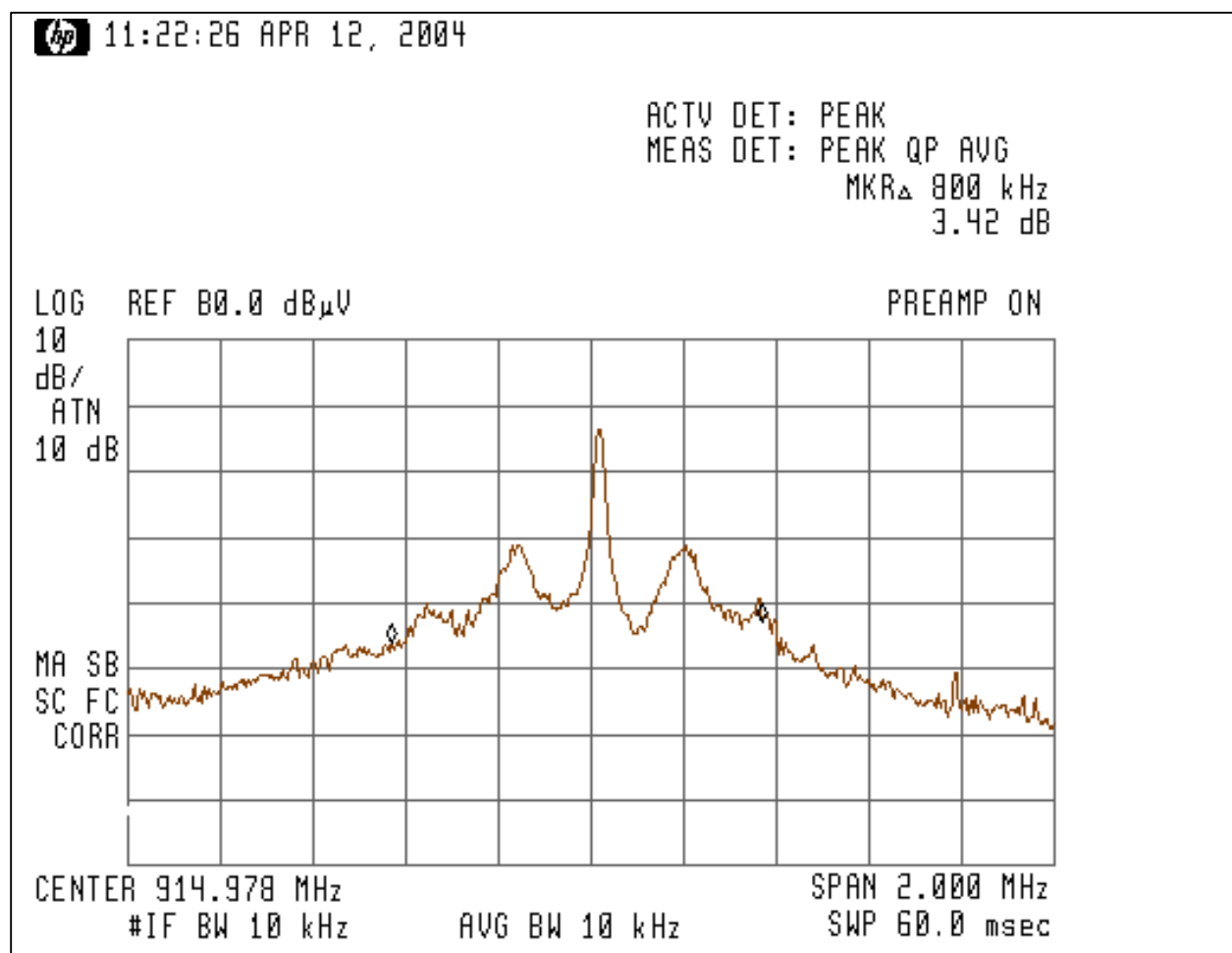
### 3.4 Bandwidth of Emissions

Bandwidth of Emissions measurements was made for frequency of 915MHz.

Bandwidth of Emissions for Base Unit at 99% power was measured at 800kHz.

The Graphs 3-4-1 below shows the Bandwidth of Emissions.

**Graph # 3-4-1**



### **3.5 Line Conducted Emissions, FCC 15.207**

Line Conducted Emissions testing was performed in frequency range from 150kHz to 30MHz. The dimmer function of the Repeater was disabled during testing (See Section 2.1)

The Table 3-5-1 and Graph 3-5-1 show the Line Conducted Emissions.

*TILE Instrument Control System EMI Measurement Software*

**Conducted Emissions**      **Date:** 4/8/2004  
**Company:** Electrolux Home Products  
**Model:** Freezer Controller and user interface  
**Test Engineer:** Troy Ihle  
**Standard:** FCC Part 15.207  
**Note:** The table shows the worst case conducted emissions  
All measurements were taken using a CISPR Quasi-peak detector

**Table # 3-5-1**

**Line 1**

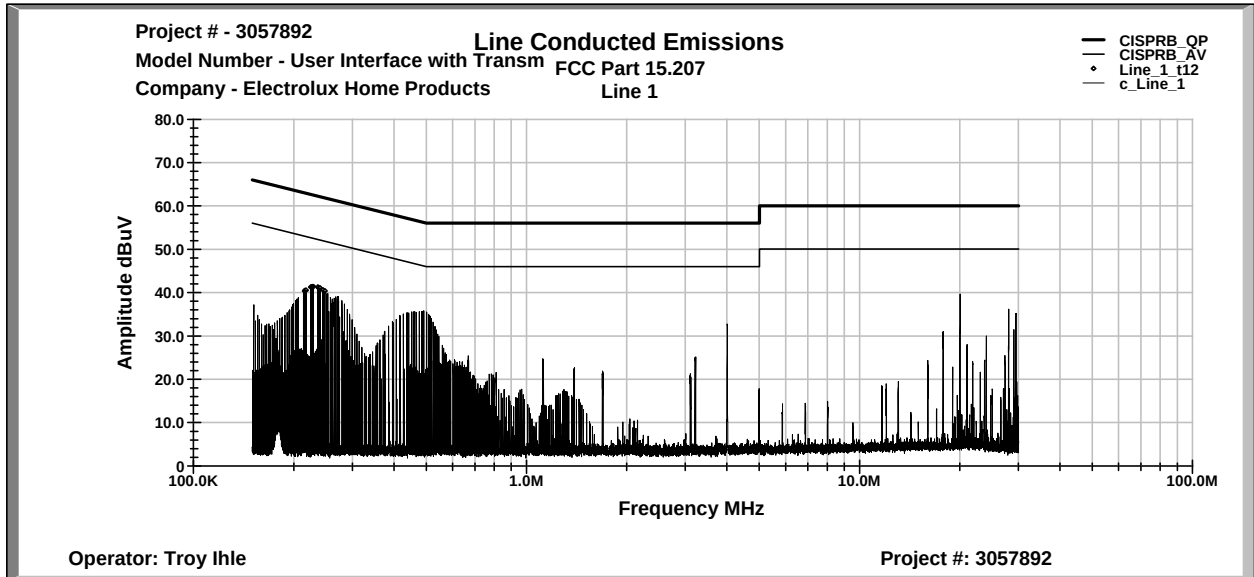
| Frequency  | QP<br>dB $\mu$ V | AVG<br>dB $\mu$ V | QP Limit<br>dB $\mu$ V | AVG Limit<br>dB $\mu$ V | QP Margin<br>dB | AVG Margin<br>dB |
|------------|------------------|-------------------|------------------------|-------------------------|-----------------|------------------|
| 220.98 KHz | 33.2             | 4.5               | 64.0                   | 54.0                    | -30.8           | -49.5            |
| 222.04 KHz | 33.4             | 4.2               | 63.9                   | 53.9                    | -30.6           | -49.8            |
| 224.16 KHz | 33.6             | 4.9               | 63.9                   | 53.9                    | -30.3           | -49.0            |
| 230.22 KHz | 33.8             | 4.6               | 63.7                   | 53.7                    | -29.9           | -49.1            |
| 230.25 KHz | 33.7             | 5.1               | 63.7                   | 53.7                    | -30.0           | -48.6            |
| 230.89 KHz | 33.8             | 4.7               | 63.7                   | 53.7                    | -29.9           | -49.0            |
| 230.95 KHz | 33.7             | 5.0               | 63.7                   | 53.7                    | -30.0           | -48.7            |
| 231.97 KHz | 33.7             | 4.7               | 63.7                   | 53.7                    | -30.0           | -49.0            |
| 233.74 KHz | 33.6             | 5.1               | 63.6                   | 53.6                    | -30.0           | -48.5            |
| 233.89 KHz | 33.6             | 5.5               | 63.6                   | 53.6                    | -30.0           | -48.2            |
| 237.89 KHz | 33.6             | 5.4               | 63.5                   | 53.5                    | -29.9           | -48.1            |
| 241.28 KHz | 33.4             | 5.0               | 63.4                   | 53.4                    | -30.0           | -48.4            |

**Line 2**

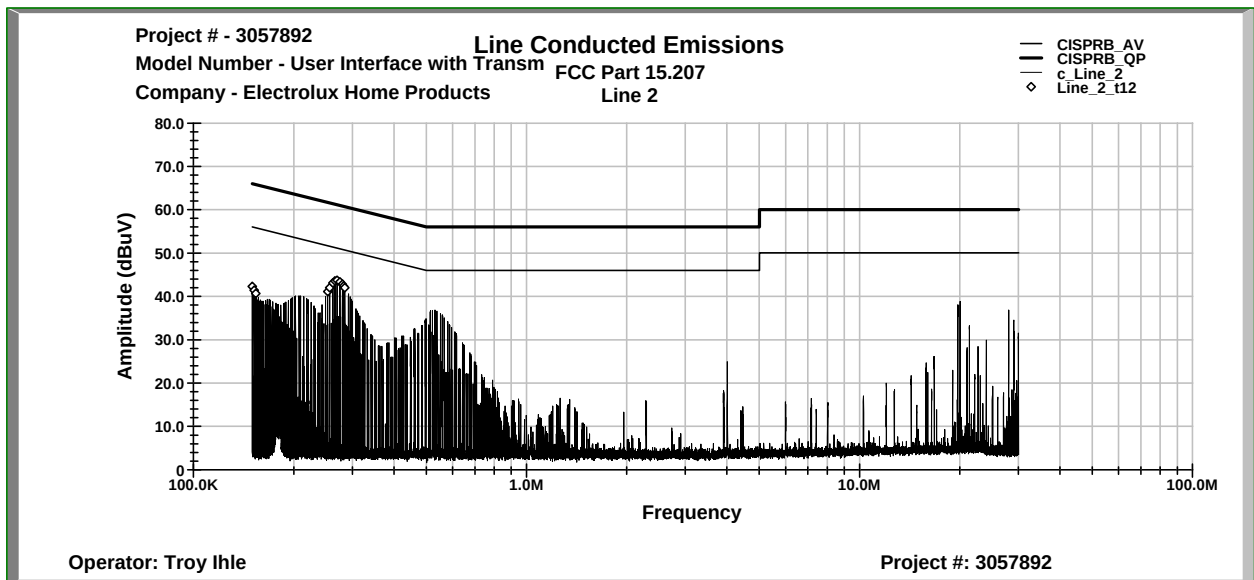
| Frequency  | QP<br>dB $\mu$ V | AVG<br>dB $\mu$ V | QP Limit<br>dB $\mu$ V | AVG Limit<br>dB $\mu$ V | QP Margin<br>dB | AVG Margin<br>dB |
|------------|------------------|-------------------|------------------------|-------------------------|-----------------|------------------|
| 150.0 KHz  | 36.9             | 7.1               | 66.0                   | 56.0                    | -29.1           | -48.9            |
| 150.05 KHz | 36.9             | 7.3               | 66.0                   | 56.0                    | -29.1           | -48.7            |
| 150.21 KHz | 36.7             | 6.8               | 66.0                   | 56.0                    | -29.3           | -49.2            |
| 259.52 KHz | 34.9             | 4.6               | 62.9                   | 52.9                    | -27.9           | -48.3            |
| 263.76 KHz | 35.7             | 5.8               | 62.8                   | 52.8                    | -27.0           | -46.9            |
| 269.1 KHz  | 36.2             | 5.4               | 62.6                   | 52.6                    | -26.4           | -47.2            |
| 269.6 KHz  | 36.1             | 5.3               | 62.6                   | 52.6                    | -26.4           | -47.3            |
| 269.61 KHz | 36.2             | 5.3               | 62.6                   | 52.6                    | -26.4           | -47.3            |
| 270.58 KHz | 36.2             | 5.2               | 62.6                   | 52.6                    | -26.4           | -47.3            |
| 272.46 KHz | 36.1             | 6.0               | 62.5                   | 52.5                    | -26.4           | -46.6            |
| 274.5 KHz  | 36.0             | 5.9               | 62.4                   | 52.4                    | -26.5           | -46.6            |
| 276.94 KHz | 35.7             | 5.3               | 62.4                   | 52.4                    | -26.7           | -47.0            |

# Graph # 3-5-1 Line Conducted Emissions

## Line 1



## Line 2



### **3.6 Test Procedure**

#### Field Strength Measurements

The EUT was placed on a non-conductive table 0.8m above the ground plane inside the Anechoic Chamber. The table was centered on a motorized turntable, which allows 360-degree rotation. The measurement antenna was positioned at 3m distance. The Bicono-Log antenna was used in frequency range from 30MHz to 1GHz, and the Horn antenna was used in frequency range above 1GHz. The radiated emissions were maximized by configuring the EUT, by rotating the EUT, by changing antenna polarization, and by changing antenna height from 1 to 4m. Method of the direct Field Strength Calculation is shown in Section 3.7.

#### Conducted Emissions

For conducted emissions testing, the equipment is moved to an insulating platform over the ground plane, and the EUT is powered from a LISN. Both sides of the AC line are measured and the results are compared to the applicable limits. Measurements are taken using CISPR quasi-peak and average detectors when the peak readings approach or exceed the average limit. Only quasi-peak readings are taken when the emissions from the EUT meet the average limit as measured with the quasi-peak detector.

### 3.7 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured emissions reading on the EMI Receiver.

The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where: FS = Field Strength in dB(μV/m)

RA = Receiver Amplitude in dB(μV)

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB(m<sup>-1</sup>)

AG = Amplifier Gain in dB

Assume a receiver reading of 48.1 dB(μV) is obtained. The antenna factor of 7.4 dB(m<sup>-1</sup>) and cable factor of 1.6 dB is added and amplifier gain of 16.0 dB is subtracted giving field strength of 41.1 dB(μV/m).

$$RA = 48.1 \text{ dB}(\mu\text{V})$$

$$AF = 7.4 \text{ dB}(\text{m}^{-1})$$

$$CF = 1.6 \text{ dB}$$

$$AG = 16.0 \text{ dB}$$

$$FS = RA + AF + CF - AG$$

$$FS = 48.1 + 7.4 + 1.6 - 16.0$$

$$FS = 41.1 \text{ dB}(\mu\text{V}/\text{m})$$

In the tables the Cable correction factors are included to the Antenna Factors.

Tested by:

Norman Shpilsher  
Sr. EMC Engineer  
Intertek ETL SEMKO

Signature



Date: April 28, 2004

## 4.0 TEST EQUIPMENT

### Receivers/Spectrum Analyzers and Test Software

| DESCRIPTION                        | SERIAL NO. | LAST CAL | CAL DUE | USED |
|------------------------------------|------------|----------|---------|------|
| HP85462A Receiver RF Section       | 3325A00106 | 08/03    | 08/04   | X    |
| HP85460A RF Filter Section         | 3330A00109 | 08/03    | 08/04   | X    |
| HP85462A Receiver RF Section       | 3549A00306 | 01/04    | 01/05   |      |
| HP85460A RF Filter Section         | 3448A00276 | 01/04    | 01/05   |      |
| Advantest Spectrum Analyzer R3271A | 55050084   | 06/03    | 06/04   | X    |
| TILE! Instrument Control System    | ver. 3.2 X | N/A      | N/A     | X    |

### Antennas

| DESCRIPTION                        | SERIAL NO. | LAST CAL | CAL DUE | USED |
|------------------------------------|------------|----------|---------|------|
| Schaffner-Chase Bicono-Log Antenna | 2468       | 01/04    | 01/05   | X    |
| Schaffner-Chase Bicono-Log Antenna | 2630       | 06/03    | 06/04   |      |
| EMCO Horn Antenna 3115             | 9507-4513  | 12/03    | 12/04   |      |
| EMCO Horn Antenna 3115             | 6579       | 01/04    | 01/05   | X    |

### Artificial Mains Networks/Absorbing Clamps

| DESCRIPTION      | SERIAL NO. | LAST CAL | CAL DUE | USED |
|------------------|------------|----------|---------|------|
| FCC LISN-2       | 316        | 01/04    | 01/05   | X    |
| FCC-LISN-50-25-2 | 2014       | 06/03    | 06/04   |      |